

CORRESPONDENCE.

HISTORICAL NOTE ON HEAVISIDE'S OPERATIONAL METHOD.

To the Editor of the *Mathematical Gazette*.

SIR,—I feel that one passage in the Note by Dr. N. W. McLachlan in the *Gazette*, July 1938, pp. 255-260, requires amendment. I refer to his statement that “ Bromwich established the validity of Heaviside's Expansion Theorem ” and his view that it may now be used freely and without question.

It is certainly the case that this theorem is true for the ordinary differential equation with constant coefficients, but its validity has not been proved for partial differential equations and in these it is often applied.

In the former case the zeros of the denominator of the expression $f(p)/F(p)$ are finite in number. In the other they may be infinite and the partial fraction rule need not be true.

In the method illustrated in my paper in the same issue of the *Gazette* this point arises in the problems treated in sections 11, 12 and 14. In applying the Theory of Residues the radius of the circle Γ is taken to be a function of n such that no zero lies on its circumference, and n then tends to infinity.

To make the proof completely rigorous one should verify that the solution as found does in fact satisfy the original differential equation and the initial and boundary conditions. It is fortunate that in the equation of conduction such verification seems generally possible ; but it must be admitted that in other differential equations of applied mathematics this offers more serious difficulty. A good deal of work has been done in this field by Doetsch and Churchill.

Yours faithfully,

H. S. CARSLAW.

To the Editor of the *Mathematical Gazette*.

SIR,—I fear that Professor Carslaw has read into my remarks on Heaviside's expansion theorem a generality I had not intended. I am in agreement with his views on that subject. In my forthcoming book entitled, *Complex Variable and Operational Calculus with Technical Applications* (Cambridge University Press), the procedure is based upon a particular case of the Mellin inversion theorem, which is substantially what Professor Carslaw now advocates. My MS. was completed in July 1937, *i.e.* twelve months before Professor Carslaw's paper appeared in the *Mathematical Gazette*.* It is interesting to find that a pure mathematician and an engineer have arrived independently at a similar viewpoint. Although on the general issue our views converge, it is possible that on questions of rigour they may diverge. I have expressed my attitude respecting rigour † in the preface as follows : “ The technologist is not fitted by training, nor has he the time, to delve into rigour to the last epsilon. Just as the mathematician does not need to be versed in thermodynamics and internal combustion engine design to drive a motor-car, the technologist need not know how to prove all the mathematical theorems he uses. But like the mathematical motorist he must be acquainted with the highway code. In other words some rigour is needed, and I hope that in this volume a happy mean has been struck between the demands of the mathematician on the one hand, and the requirements of the practical man on the other.”

N. W. McLACHLAN.

* 22, 264, 1938.

† See also *Math. Gazette*, 19, 217, 1935, and *Wireless Engineer*, May 1935 (Correspondence).